

(12) **UK Patent Application** (19) **GB** (11) **2 344 463** (13) **A**

(43) Date of A Publication 07.06.2000

(21) Application No 9928725.2

(22) Date of Filing 03.12.1999

(30) Priority Data

(31) 10346025 (32) 04.12.1998 (33) JP

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(51) INT CL<sup>7</sup>

**H01L 23/488**

(52) UK CL (Edition R )

**H1K KRG**

(56) Documents Cited

**US 5011066 A**

(58) Field of Search

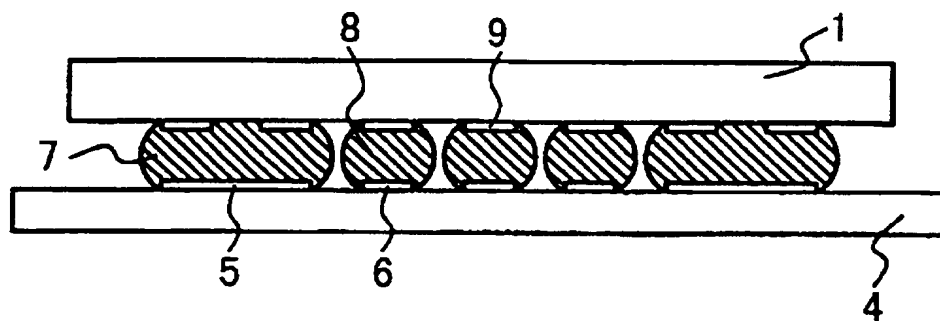
UK CL (Edition R ) **H1K KRD KRG KRK , H1R RAA1 RAB**  
INT CL<sup>7</sup> **H01L 23/485 23/498 , H05K 1/02 1/18 3/34**  
**EPOQUE: WPI, EPODOC, PAJ**

(54) Abstract Title

**Mounting a ball grid array device on a printed circuit board**

(57) A back electrode type electronic device 1 includes electrodes 9 to be connected to substrate electrodes 6 on a printed circuit board 4. At least one group of electrodes 9 in a designated portion of the device 1 is provided to be bonded with a single first solder ball 7 to an enlarged substrate electrode 5. The remaining device electrodes are connected to substrate electrodes by smaller solder balls 8. The designated portions of the device may be all four corners.

**Fig. 5**



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Fig. 1 PRIOR ART

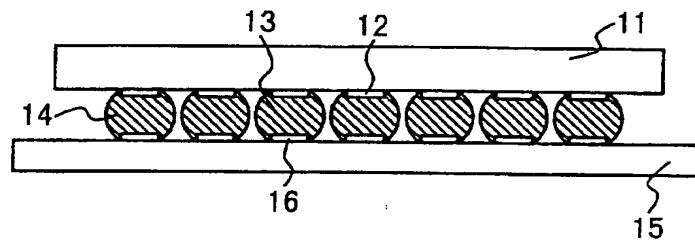


Fig. 2

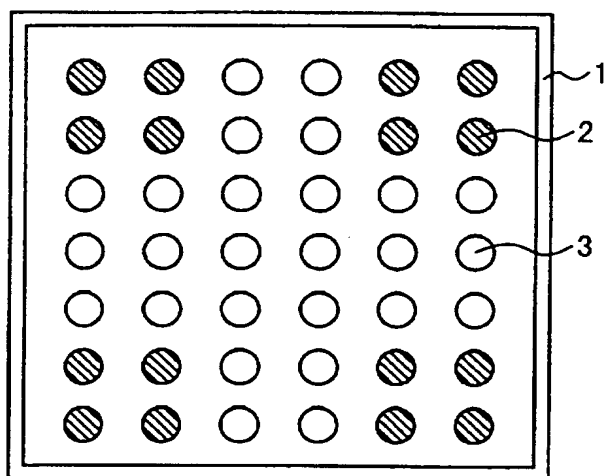


Fig. 3

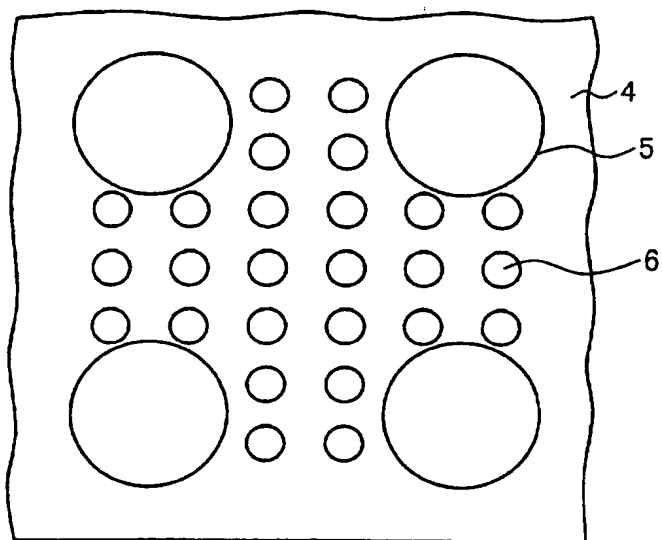


Fig. 4

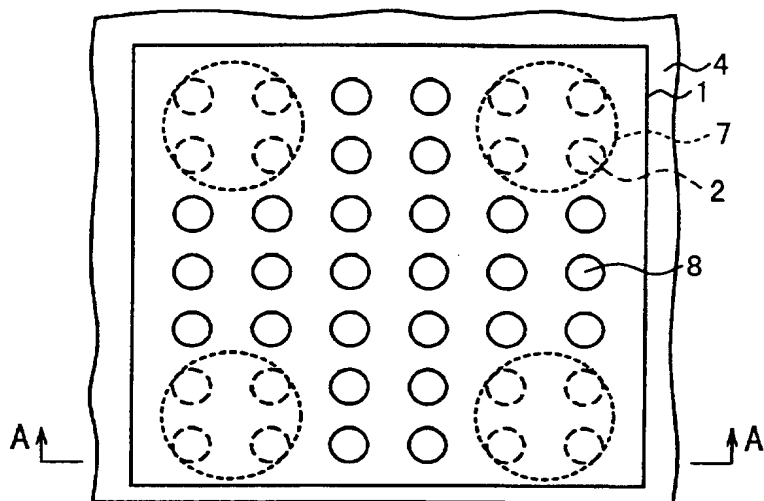


Fig. 5

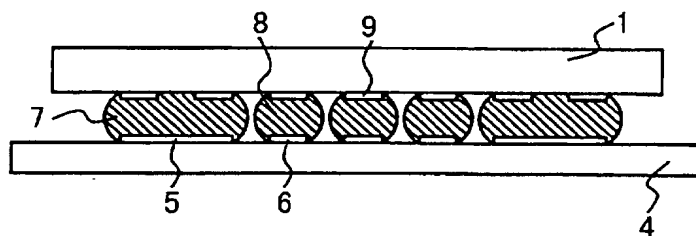


Fig. 6

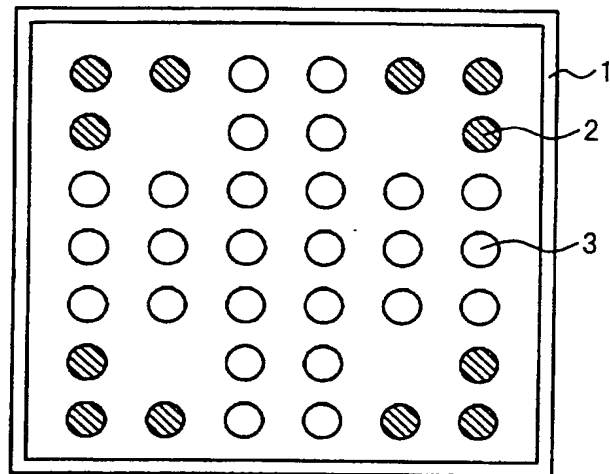
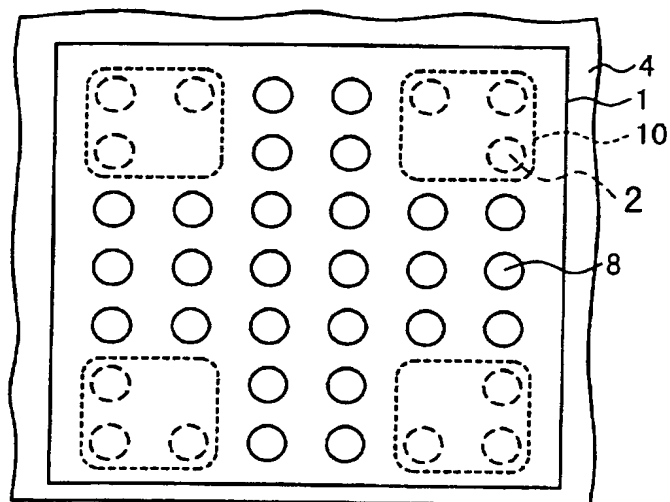


Fig. 7



BACK ELECTRODE TYPE ELECTRONIC PART  
AND ELECTRONIC ASSEMBLY WITH THE SAME  
MOUNTED ON PRINTED CIRCUIT BOARD

5 Background of the Invention

1. Field of the Invention

The present invention relates to a back  
electrode type electronic part and an electronic  
assembly with the same mounted on a printed  
10 circuit board.

2. Description of the Related Art

With appearance of a small size electronic  
appliance such as a portable information terminal,  
a back electrode type or a Ball Grid Array (BGA)  
15 type electronic part used in such an electronic  
appliance is made small in size. Also, a BGA  
electrode is made small. Therefore, a soldering  
connection section between the BGA type  
electronic part and a printed circuit board in  
20 the electronic appliance is made small so that  
the endurance to heat cycle stress and external  
stress is decreased.

Fig. 1 shows a cross sectional view of an  
electronic assembly with a printed circuit board  
25 on which a known BGA type electronic part  
is mounted. Referring to Fig. 1, solder balls 13  
are provided between electrode lands 12 of the

electronic part 11 and electrode lands 16 of the printed circuit board 15. Especially, the solder balls on the corners are shown by a reference numerals 14.

5           In Japanese Laid Open Patent Application (JP-A-Heisei 10-56093), a semiconductor device and an electric appliance in which the semiconductor device is incorporated are described. In this reference, a dummy electrode  
10 is provided in a corner section of a BGA electrode arrangement while one substrate electrode corresponds to one part electrode. Thus, even if a crack is generated in a solder connection section of the dummy electrode due to  
15 heat cycles, solder connection of a signal electrode is guaranteed.

A heat cycle stress may be applied to the printed circuit board on which the BGA type  
20 electronic part is mounted, due to environment temperature change and change of the heating of BGA type electronic part itself. At this time, any warp is caused by the difference in thermal expansion percentage between the BGA type  
25 electronic part and the printed circuit board. This warp often centers on the solder connection sections in 4 peripheral corner sections of

electrode arrangement of the BGA type electronic part. When the solder connection section is not endured for this warp, there is the high possibility that the crack is generated in the  
5 solder connection section.

Also, when an external stress is applied to the printed circuit board on which the BGA type electronic part is mounted, to bend the board, the 4 corner sections of the electrode  
10 arrangement of the BGA type electronic part are easiest to receive stress transformation most. This is because there are few neighbor electrodes by which the stress can be dispersed and the transformation of the printed circuit board due  
15 to the external stress becomes the largest. The destruction of the solder connection section through the stress transformation often progresses from the 4 corner sections toward the inside of the electrode arrangement.

20 In conjunction with the above description, a chip carrier is disclosed in Japanese Laid Open Patent Disclosure (JP-A-Heisei 4-314355). In this reference, positioning pads are provided on a back surface of a chip carrier to have a larger  
25 area than connection pads. A conductive circuit is provided on a substrate to have a larger area than a connection conductive circuit



corresponding to the connection pad. The chip carrier is preliminarily soldered and the chip carrier is positioned on the substrate. Then, reflow is carried out. Thus, the positioning is  
5 carried out by use of solder balls for the positioning pads and then the connection pads are connected to the substrate.

Also, a semiconductor device is disclosed in Japanese Laid Open Patent Disclosure (JP-A-  
10 Heisei 9-330993). In this reference, a solder bump forming land 3 is separately formed as lands 3a and 3b in a BGA structure. After the semiconductor chip 1 is molded, a test is carried out by use of the lands 3a and 3b. Thereafter,  
15 when a solder bump is formed, lands 3a and 3b are electrically connected by a single solder bump.

Also, a BGA semiconductor device is disclosed in Japanese Laid Open Patent Disclosure (JP-A-Heisei 7-321247). In this reference, a pad  
20 14 is formed to have a shape in which a length in a direction of a line passing through a transformation center 12 is larger than that in a direction orthogonal to the line. Thus, a contact angle in a direction of generation of thermal  
25 warp is made larger than a conventional device so that a solder life to the thermal warp is elongated.

Also, a surface mounting type semiconductor package is disclosed in Japanese Laid Open Patent Disclosure (JP-A-Heisei 9-307022). In this reference, a semiconductor package 3 has a  
5 rectangular package body 15. Solder balls 22 which are covered by a solder layer 23 are arranged in a matrix on a back surface 16b of the package body. The solder balls are soldered to pads 8 of a printed circuit board 2 by reflow.  
10 The solder balls 22a in the outermost of an arrangement area of the solder balls have a larger diameter than the other solder balls.

In addition, a BGA electronic part is disclosed in Japanese Registered Utility Model No.  
15 3012948. In this reference, dummy terminals 8 are provided in a region of soldering sections where any crack is easy to be generated due to heat cycles. The dummy terminals are arranged in an outermost portion or corner portions of the  
20 terminal arrangement.

### Summary of the Invention

In accordance with the present invention there is provided a back electrode type electronic part comprising a main body including a circuit, and  
5 electrodes arranged for solder bumps on a back surface portion of said electronic part and connected to said circuit, and wherein each of groups of said electrodes at portions of the electrode arrangement is provided for a single first solder bump which is larger than  
10 second solder bumps for said electrodes arranged other than said corner portions, and wherein said group of electrodes includes electrodes having a substantially same potential level when said circuit operates.

The electrodes may be arranged in a matrix,  
15 and the corner portions may be 4 corner portions.

Also, the group of electrodes may include a non-contact electrode which is not connected to the circuit.

Also, one of the electrodes of the group may  
20 be a signal electrode, a ground potential electrode, or a power supply potential electrode.

In accordance with a second aspect the invention provides an electronic assembly comprising:  
a back electrode type electronic part comprising a  
25 main body including a circuit, and electrodes provided

on a back surface portion of said electronic part and  
connected to said circuit; wherein groups of said  
electrodes at portions of the electrode arrangement is  
groups of integrated electrodes, and wherein said  
5 group of integrated electrodes includes said  
electrodes having a substantially same potential level  
when said circuit operates, a printed circuit board  
having substrate electrodes corresponding to said  
electrodes provided for said electronic part, wherein  
10 one of said substrate electrodes as a first substrate  
electrode is provided for each of said groups of  
integrated electrodes, and said substrate electrodes  
as second substrate electrodes other than said first  
substrate electrodes are provided for said electrodes  
15 of said electronic part other than said integrated  
electrodes, and solder bumps including first solder  
bumps connected with said groups of integrated  
electrodes and said first substrate electrodes and  
second solder bumps connected with said second  
20 substrate electrodes and said electrodes of said  
electronic part other than said integrated electrodes.

Again, the electrodes of the electronic part  
may be arranged in a matrix, and the portions are 4  
corner portions. One of the integrated electrodes of  
25 the group may be a non-contact electrode which is not

connected to the circuit, a signal electrode or a power supply potential electrode.

#### Brief Description of the Drawings

The invention will now be described in more detail, by way of example, with reference to the drawings, in which:

Fig. 1 is a cross sectional view showing the state in which a known BGA type electronic part is mounted on a printed circuit board;

Fig. 2 is a back plan view showing the electrode arrangement of a BGA type electronic part according to a first embodiment of the present invention;

Fig. 3 is a partial plan view showing the electrode arrangement of a printed circuit board on which the BGA type electronic part of Fig. 2 is mounted;

Fig. 4 is a plan view showing the state in which the BGA type electronic part of Fig. 2 is mounted on the printed circuit board of Fig. 3;

Fig. 5 is a cross sectional view along the line A-A of Fig. 4 when the BGA type electronic

part of Fig. 2 is mounted on the printed circuit board of Fig. 3;

Fig. 6 is a plan view showing the electrode arrangement of the BGA type electronic part according to a second embodiment of the present invention; and

Fig. 7 is a plan view showing the state in which the BGA type electronic part of Fig. 6 is mounted on the printed circuit board.

10

#### Description of the Preferred Embodiments

Hereinafter, a back electrode type electronic part and an assembly in which the back electrode type electronic part is mounted on a printed circuit board will be described

Fig. 2 is a back plan view showing a back electrode type or BGA type electronic part according to the first embodiment of the present invention. A reference numeral 1 in Fig. 2 denotes the BGA type electronic part, 2 denotes integration possible specific electrodes, and 3 denotes a general electrodes. The electronic part includes a circuit (not shown) therein and the specific electrodes 2 and the general electrodes 3 are connected to the circuit. In the first embodiment, a set of four ground potential electrodes as the specific electrodes 2 are

provided at each of four corner sections of the BGA type electronic part 1. As seen from Fig. 2, the electrodes are arranged in a matrix with a constant distance between adjacent ones in a row direction or a column direction. However, the pitch between the specific electrodes may be shorter than the pitch between the general electrodes. Also, in Fig. 3, all the electrodes have the same size. However, the specific electrode may be different from the general electrode in size. For example, the specific electrode may be larger or smaller than the general electrode.

Although ground potential electrodes are used as the specific electrodes, other electrode may be used as the specific electrodes. For example, the following electrodes shown by ① to ⑦ may be used as a set of integration possible electrodes. That is,

① the ground potential electrodes are gathered or are provided newly for a set;

② non-contact electrodes which are not connected to the circuit of the electronic part 1 are gathered or are provided newly for a set;

③ signal electrodes which having a same signal level when the circuit operates are gathered or are provided newly for a set;

④ power supply potential electrodes are

gathered or are provided newly for a set;

⑤ ground potential electrodes and non-contact electrode electrodes are gathered for a set;

⑥ same signal electrodes and non-contact  
5 electrode electrodes are gathered for a set; and

⑦ power supply electrodes and non-contact  
power supply electrodes are gathered for a set.

Fig. 3 shows a printed circuit board on  
which the BGA type electronic part 1 shown in Fig.  
10 2 is mounted. In Fig. 3, a reference numeral 4  
denotes a substrate, 5 denotes an integration  
electrode and 6 denotes a general electrode. The  
substrate 4 in this embodiment has an integration  
electrode 5 for the specific electrodes 2 in the  
15 BGA type electronic part shown in Fig. 2 and a  
general electrode 6 for the general electrode 3.  
The integration electrodes are provided at the  
four corner sections and the four specific  
electrode are integrated into the same  
20 integration electrode 5. By this, the solder  
connection section is made large so that it is  
made possible to improve the connection strength  
between the soldered BGA type electronic part and  
the printed circuit board.

25 Fig. 4 shows the state in which the BGA  
type electronic part shown in Fig. 1 is soldered  
to the printed circuit board 4 shown in Fig. 3.



The group of specific electrodes 2 of the BGA type electronic part 1 are soldered to the integration electrode 5 of the printed circuit board 4. At this time, as shown in Fig. 5, a solder bump for the specific electrodes 2 of the BGA type electronic part and the integration electrode 5 is large. The solder bump for the general electrode 3 of the BGA type electronic part and the general electrode 6 of the printed circuit board 4 is small.

That is, the large solder connection section between the specific electrodes 2 of the BGA type electronic part and the integration electrode 5 of the printed circuit board 4. As a result, the connection strength of the solder connection sections in the four corner sections is improved increasingly. Therefore, it becomes possible to prevent generation of any crack due to the above-mentioned heat cycle stress and destruction due to the external stress, resulting in improvement of the reliability of the mounted BGA type electronic part.

In the present invention, the number of specific electrodes gathered at each of the four corner sections is not limited to 4 electrodes, and may be an optional number. For example, as shown in Fig. 6, three specific electrodes 3,

namely, the specific electrode 2 situated in each of the four corner of the BGA type electronic part 1 and the two electrodes 2 arranged along the edge section of the BGA type electronic part 1 and located in the neighborhood to the above electrode 2 are set as the integration possible specific electrodes. Also, the number of integration electrodes is not limited to four. The number of integration electrodes may be an optional number.

Also, as shown in Fig. 7, a square integration electrode 10 is provided for the substrate 4 to mount the BGA type electronic part 1 shown in Fig. 6. This integration electrode 10 is connected with three specific electrodes 2 of the BGA type electronic part 1 shown in Fig. 6 with solder.

The integration electrode provided on the substrate 4 may be circular as shown in Fig. 3 and Fig. 4, rectangular as shown in Fig. 7, or optional shapes such as an ellipse and an oval shape.

In the illustrated embodiments, the group of specific electrodes is soldered to the integration electrode of the substrate while the general electrodes of the BGA type electronic part are connected with the general electrodes of the

printed circuit board. The solder connection section of the specific electrodes of the BGA type electronic part is enlarged in each of the four corner sections. Therefore, the connection strength of the soldering section in the four corners is increased. Also, it is possible to prevent generation of the crack due to the above-mentioned heat cycle stress and the destruction due to the external stress, resulting in the improvement of the loaded reliability of the BGA type electronic part.

**CLAIMS:**

1. A back electrode type electronic part comprising:

a main body including a circuit; and

electrodes arranged for solder bumps on a back  
5 surface portion of said electronic part and connected  
to said circuit, and

wherein each of groups of said electrodes at  
portions of the electrode arrangement is provided for  
a single first solder bump which is larger than second  
10 solder bumps for said electrodes arranged other than  
said corner portions, and

wherein said group of electrodes includes  
electrodes having a substantially same potential level  
when said circuit operates.

2. A back electrode type electronic part according  
to claim 1, wherein said electrodes are arranged in a  
matrix, and said portions are 4 corner portions.

3. A back electrode type electronic part according  
to claim 1 or 2, wherein said group of electrodes  
includes a non-contact electrode which is not  
connected to said circuit.

4. A back electrode type electronic part according  
to any of claims 1 to 3, wherein one of said

electrodes of said group is a signal electrode.

5. A back electrode type electronic part according to any of claims 1 to 3, wherein one of said electrodes of said group is a ground potential electrode.

6. A back electrode type electronic part according to any of claims 1 to 3, wherein one of said electrodes of said group is a power supply potential electrode.

7. An electronic assembly comprising:  
a back electrode type electronic part  
comprising:

5 a main body including a circuit, and  
electrodes provided on a back surface  
portion of said electronic part and connected to said  
circuit, wherein groups of said electrodes at portions  
of the electrode arrangement is groups of integrated  
electrodes, and wherein said group of integrated  
10 electrodes includes said electrodes having a  
substantially same potential level when said circuit  
operates;

a printed circuit board having substrate  
electrodes corresponding to said electrodes provided  
15 for said electronic part, wherein one of said

substrate electrodes as a first substrate electrode is  
provided for each of said groups of integrated  
electrodes, and said substrate electrodes as second  
substrate electrodes other than said first substrate  
5 electrodes are provided for said electrodes of said  
electronic part other than said integrated electrodes;  
and

solder bumps including first solder bumps  
connected with said groups of integrated electrodes  
10 and said first substrate electrodes and second solder  
bumps connected with said second substrate electrodes  
and said electrodes of said electronic part other than  
said integrated electrodes.

8. An electronic assembly according to claim 7,  
15 wherein said electrodes of said electronic part are  
arranged in a matrix, and said portions are 4 corner  
portions.

9. An electronic assembly according to claim 7,  
wherein one of said integrated electrodes of said  
20 group is a non-contact electrode which is not  
connected to said circuit.

10. An electronic assembly according to claims 7 to 9, wherein one of said integrated electrodes of said group is a signal electrode.

5 11. An electronic assembly according to any of claims 7 to 9, wherein one of said electrodes of said group is a ground potential electrode.

12. An electronic assembly according to any of claims 7 to 9, wherein one of said electrodes of said group is a power supply potential electrode.

10 13. A back electrode type electronic part, substantially as herein described with reference to Fig. 2 et seq of the drawings.

14. An electronic assembly incorporating a back electrode type electronic part in accordance with  
15 claim 13.



Application No: GB 9928725.2  
Claims searched: 1-14

Examiner: Emma Rendle  
Date of search: 10 February 2000

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:  
UK Cl (Ed.R): H1K (KRD, KRG, KRK); H1R (RAA, RAB)  
Int Cl (Ed.7): H01L 23/485, 23/498; H05K 1/02, 1/18, 3/34  
Other: EPOQUE: WPI, EPODOC, PAJ

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage  | Relevant to claims |
|----------|--|--------------------|
| X        | US 5 011 066 (MOTOROLA) see whole document, especially column 2 lines 10-17, 29-35 and column 3 lines 17-20. | 1-12               |

|   |   |   |  |
|---|---|---|--|
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| Y | Document indicating lack of inventive step if combined with one or more other documents of same category. | P | Document published on or after the declared priority date but before the filing date of this invention.          |
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